CLIMATE CHANGE MODELS: DR. DANIEL LASHOF;
Congressional Testimony 07-25-2002

Statement of Dr. Daniel Lashof Deputy Director, Climate Center Natural Resources Defense Council Committee on House Energy and Commerce Subcommittee on Oversight and Investigations The U.S. National Climate Change Assessment: Do the Climate Models Project a Useful Picture of Regional Climate? July 25, 2002 Introduction Thank you Mr. Chairman and members of the committee. My name is Daniel Lashof, and I am the Science Director of the Natural Resources Defense Council`s Climate Center. I appreciate the opportunity to appear before you today. I have been engaged in research and assessment related to global climate change for more than 15 years. I was a reviewer of the National Assessment Synthesis Report. I have also served as a Lead Author of the Intergovernmental Panel on Climate Change Special Report Land Use, Land-Use Change, and Forestry and as a reviewer of several reports by the panel. I have also served on the National Research Council`s Committee on Atmospheric Chemistry and on the Energy Research and Development Panel of the Presidents` Committee of Advisers on Science and Technology. Previously I served on the Federal Advisory Committee on Options for Reducing Greenhouse Gas Emissions from Personal Motor Vehicles. I hold a bachelor's degree in physics and mathematics from Harvard University and a doctorate in Energy and Resources from the University of California at Berkeley. The Natural Resources Defense Council (NRDC) is a national, non- profit organization of scientists, lawyers, and environmental specialists, dedicated to protecting public health and the environment. Founded in 1970, NRDC serves more than 500,000 members from offices in New York, Washington, Los Angeles, and San Francisco. In my statement today I will address the value of using climate models to assess the potential effects of global warming on the Untied States and illustrate this by reviewing the results of a recent study published by NRDC and Defenders of Wildlife on the threat posed by global warming to trout and salmon. Experimenting on the Earth`s Climate Mr. Chairman, there is only one earth. It is therefore impossible to conduct a controlled physical experiment that compares an ``experimental`` earth with elevated concentrations of carbon dioxide (CO2) and other heat-trapping gases to a ``control`` earth with an unpolluted atmosphere. Instead we are currently conducting an uncontrolled experiment in which emissions from power plants, automobiles and other sources are adding to a thickening layer of carbon pollution in the only atmosphere we have. The problem is that if we don`t like the consequences of this experiment it will be too late to reverse them. Given our one-earth experimental design, which I

don`t think even Congress has the power to change, the best approach available to us is to simulate the earth`s climate system using all available data on the composition of the atmosphere, the properties of the earth`s surface, and the conditions of the earth`s oceans combined with mathematical equations that describe the fundamental physical laws of motion and conservation of mass and energy. This is called climate modeling. Climate models allow us to conduct non-destructive controlled experiments: An ``experimental`` simulation with rising concentrations of heat- trapping gases can be compared to a ``control`` simulation with constant concentrations. The idea of using computers to simulate physical systems with mathematical models is not unique to climate modeling. Simulation models are used to test-crash cars, test-fly airplanes, and test- detonate nuclear weapons. All without the need to sweep up afterward. If computer models were inherently useless, Boeing 777`s would be falling out of the skies. In fact, it`s no accident that the Lawrence Livermore National Laboratory does both climate simulations and nuclear weapon simulations. And for the same reason. It is safer to run these tests on computer models than on the real thing. Climate models are in fact a remarkable achievement of modern science. Despite the incredible complexity of the earth`s climate system, these models are able to simulate with high fidelity the major processes that determine the variations in the earth`s climate over space and time: from the polar vortex to tropical monsoons and from the depths of winter to the heat of summer and everything in between. Are the models perfect? Of course not. Someone looking selectively for discrepancies will always be able to find something to point to and there will always be room for refinements. Nevertheless, overall the models have achieved a level of realism and accuracy that makes them very useful tools. Indeed, they are the only tool we have for safely performing experiments to investigate the effects of large-scale pollution of the atmosphere with heat-trapping gases. The Bush Administration Recognizes the Threat Posed by Global Warming The current Bush Administration has recognized the value of using simulation models to test the potential consequences of global warming on the United States in two recent reports that underwent extensive interagency review. These are the 2001 Intergovernmental Panel on Climate Change`s (IPCC) Synthesis Report of the Third Assessment Report and the U.S. Climate Action Report 2002, formally known as the Third National Communication of the United States of America Under the United Nations Framework Convention on Climate Change (UNFCCC). First, in August 2001, the State Department submitted detailed comments on the draft of the IPCC`s Synthesis Report of the Third Assessment Report. The administration carefully reviewed this report and, while suggesting some changes and clarifications, agreed with all the key findings. Furthermore, they participated fully in the IPCC Plenary meeting in September 2001, where the final IPCC TAR Synthesis Report

Summary for Policymakers (SPM) was approved in detail. Among other things, this report concludes that: ``There is new and stronger evidence that most of the warming observed over the last 50 years is attributable to human activities.`` (Climate Change 2001: Synthesis Report, SPM, p. 5) ``Projections using the SRES emissions scenarios in a range of climate models result in an increase in globally averaged surface temperature of 1.4 to 5.8 C over the period 1990 to 2100. This is about two to ten times larger than the central value of observed warming over the 20th century and the projected rate of warming is very likely to be without precedent during at least the last 10,000 years, based on paleoclimate data.`` (SPM, p. 8) ``Models project that increasing atmospheric concentrations of greenhouse gases result in changes in frequency, intensity, and duration of extreme events, such as more hot days, heat waves, heavy precipitation events, and fewer cold days. Many of these projected changes would lead to increased risks of floods and droughts in many regions, and predominantly adverse impacts on ecological systems, socio-economic sectors, and human health.`` (SPM, p. 14) Then, in May 2002, the administration released the U.S. Climate Action Report 2002 and submitted it to the Secretariat of the UNFCCC. This report is based upon conclusions by the National Academy of Sciences, the IPCC climate change reports, and the U.S. Global Change Research Program`s U.S. National Assessment of the Potential Consequences of Climate Variability and Change. It was thoroughly vetted by this administration and approved before its official release. Among the key finding of the Climate Action Report are: ``To provide an objective and quantitative basis for an assessment of the potential consequences of climate change, the U.S. National Assessment was organized around the use of climate model scenarios that specified changes in the climate that might be experienced across the United States (NAST 2001). Rather than simply considering the potential influences of arbitrary changes in temperature, precipitation, and other variables, the use of climate model scenarios ensured that the set of climate conditions considered was internally consistent and physically plausible.`` (p.84) ``Use of these model results is not meant to imply that they provide accurate predictions of the specific changes in climate that will occur over the next 100 years. Rather, the models are considered to provide plausible projections of potential changes for the 21st century. For some aspects of climate, all models, as well as other lines of evidence, are in agreement on the types of changes to be expected. For example, compared to changes during the 20th century, all climate model results suggest that warming during the 21st century across the country is very likely to be greater, that sea level and the heat index are going to rise more, and that precipitation is more likely to come in the heavier categories experienced in each region.`` (p.84) ``The model scenarios used in the National Assessment project that

the continuing growth in greenhouse gas emissions is likely to lead to annual-average warming over the United States that could be as much as several degrees Celsius (roughly 3-9``F) during the 21st century. In addition, both precipitation and evaporation are projected to increase, and occurrences of unusual warmth and extreme wet and dry conditions are expectedto become more frequent.`` (p.84) ``Natural ecosystems appear to be the most vulnerable to climate change because generally little can be done to help them adapt to the projected rate and amount of change. ``Sea level rise at mid- range rates is projected to cause additional loss of coastal wetlands, particularly in areas where there are obstructions to landward migration, and put coastal communities at greater risk of storm surges, especially in the southeastern United States. ``Reduced snow-pack is very likely to alter the timing and amount of water supplies, potentially exacerbating water shortages, particularly throughout the western United States, if current water management practices cannot be successfully altered or modified. ``Increases in the heat index (which combines temperature and humidity) and in the frequency of heat waves are very likely.`` (p.82). The clear conclusion from these findings is that global warming poses a severe threat to public health and the environment in the United States. Trout and Salmon in Hot Water A study published by NRDC and Defenders of Wildlife in May on the threat posed by global warming to trout and salmon in the United States provides one example of the kind of analysis that can be usefully performed using the regional results of global climate models. Because trout and salmon are known to be intolerant of warm water, their abundance could be threatened if future climate change warms the streams they inhabit. I ask that this report be included in the hearing record. Trout and salmon are highly valued for their contribution to the economy and culture of the United States. They thrive in the cold, clear streams found in many mountainous and northern regions of the country. About 10 million Americans spend an average of ten days per year angling in streams or lakes for these fish. Dams, water diversions, pollution, and development threaten trout and salmon, which have already disappeared from many of the streams where they were formerly found. Global warming poses a less visible but no less severe threat to their survival. To assess the magnitude of this threat we contracted with Abt Associates to perform a new simulation study of how climate change might affect existing habitat for four species of trout (brook, cutthroat, rainbow, and brown) and four species of salmon (chum, pink, coho and chinook) in streams throughout the contiguous United States. The simulation uses the results of three different climate models, including updated versions of the Canadian model (CGCM2) and the Hadley Center model (HadCm3) used in the National Assessment, as well as an Australian model (CSIRO- Mk2). The changes in air temperatures projected by these global climate models are used to project the impact

of global warming on U.S. stream temperatures, using a new, more accurate method to estimate the relationship between air and stream temperatures. Interestingly, the version of the Hadley Center model used for this study projects warming rates for the United States that are quite similar to Canadian Model results used in the National Assessment. Trout and salmon are particularly sensitive to increases in summer temperature and the Hadley Model (HadCm3) projects an increase in average July temperatures for the contiguous United States of as much as 10 degrees Fahrenheit by 2090, assuming that emissions of heat-trapping gases are not curtailed. The study found that trout and salmon habitat is indeed vulnerable to the effects of global warming. At the national level we estimate that individual species of trout and salmon could lose 5-17 percent of their existing habitat by the year 2030, 14-34 percent by 2060, and 21-42 percent by 2090, based on emissions scenarios A1 and A2 from the Intergovernmental Panel on Climate Change (IPCC), depending on the species considered and model used. Projected effects on trout and salmon are lower for IPCC scenarios B1 and B2, which assume that global CO2 emissions are reduced for reasons not directly related to global warming. For these scenarios, we estimate habitat losses of 4-20 percent by 2030, 7-31 percent by 2060, and 14-36 percent by 2090, depending on fish species and model. Of particular concern is the number of stream locations that become unsuitable for all modeled species (Exhibit 1). At the regional level, loss of trout habitat in the Northeast and the Southwest could be particularly severe, although losses are also expected in the Southeast and Rocky Mountain regions. For example, in Pennsylvania losses of trout habitat are projected to be 6-11 percent by 2030, 22-28 percent by 2060, and 33-44 percent by 2090, based on the A1 and A2 emission scenarios. Significant losses of salmon habitat are projected throughout their current range. The number of locations expected to become unsuitable for both trout and salmon expands steadily over time, assuming emissions of heat-trapping gases continue to increase (Exhibit 2). These results are robust with respect to key model specifications and assumptions. For a given emissions scenario, the greatest uncertainty is due to differences among the global climate models, yet the results provide a valuable indicator of the regions most vulnerable to loss of cold water fish habitat. Differences among the scenarios for future emissions of heat- trapping gases also significantly affect the results, even though none of the scenarios examined assumes that policies are adopted specifically to address global warming. For all emissions scenarios our results are likely to understate expected losses of habitat because of the several dimensions of climate change and potential effects on habitat that were beyond the scope of the study. These include potential effects on stream flows, changes to the temperature of groundwater discharge, changes in ocean conditions, and other considerations. In addition, these results

must be viewed within the context of other present and future threats to fish habitat, which are likely to add to the temperature-related losses estimated in the report. This analysis demonstrates that it is possible to draw robust conclusions about the vulnerability of key resources to the effects of global warming, despite variations in climate model projections. The results show that future strategies to protect trout and salmon will need to address the potential effects of global warming. Responding to the Threat of Global Warming The administration has recognized the threat posed to the United States by global warming and has reaffirmed the United States` commitment to the objective of the Framework Convention on Climate Change, which is to stabilize greenhouse gas concentrations in the atmosphere at safe levels. Nonetheless, the administration has refused to consider any mandatory limits on emissions of heat-trapping gases. This position is both illogical and irresponsible. The administration has argued, in essence, that mandatory limits on emissions of CO2 and other heat-trapping gases would harm the economy, and that therefore we should rely on voluntary measures and adapt to changes in climate. The administration has not advanced any analysis, however, to suggest that voluntary action has any chance of stabilizing greenhouse gas concentrations in the atmosphere. Indeed, the United States has now relied on voluntary measures for more than a decade and emissions have continued to increase. The administration`s claim that setting mandatory limits on emissions now would harm the economy is equally unsupported by analysis. While it is possible to construct straw-man proposals that would be costly, surely there must be some level and timetable for a CO2 emission limit that would be affordable. Yet the administration has rejected any mandatory limit out of hand. In fact, failure to set limits now will lead to stranded investments in new highly emitting power plants and other equipment that will become obsolete when limits are established in the future. Further delay in establishing mandatory limits on heat-trapping gas emissions is irresponsible because our window for taking action in time to stabilize greenhouse gas concentrations at safe levels is rapidly closing. The IPCC Synthesis Report cited earlier, which was adopted with the full participation of the administration, makes this quite clear: ``The severity of the adverse impacts will be larger for greater cumulative emissions of greenhouse gases and associated changes in climate.`` (SPM p.9) ``Inertia is a widespread inherent characteristic of the interacting climate, ecological, and socieconomic systems. Thus some impacts of anthropogenic climate change may be slow to become apparent, and some could be irreversible if climate change is not limited in both rate and magnitude before associated thresholds, whose positions may be poorly known, are crossed.`` (SPM p. 16) ``The pervasiveness of inertia and the possibility of irreversibility in the interacting climate, ecological, and socio-economic systems are major reasons why anticipatory

adaptation and mitigation actions are beneficial. A number of opportunities to exercise adaptation and mitigation options may be lost if action is delayed.`` (SPM p. 18) Mr. Chairman, global warming poses a clear threat to the United States. The good news is that this is a threat that we know how to stop. Now is the time to set mandatory limits on emissions of heat-trapping gases. Thank you.